

## Advanced Power Electronics

ORNL Floating Loop Integrated Hybrid  
Electric Vehicle Cooling System

## Background

It is of continuing interest in the hybrid electric vehicle arena to increase power density and decrease weight and volume in the hybrid drive train. Vehicle cooling systems range across several types of systems and fluids, such as radiator coolant (water/ethylene glycol), transmission fluid (oil), and passenger air conditioning refrigerant (presently R134a). Hybrid drive trains on the market today are using radiator coolant loops to cool the power electronics and traction motors. In order to enable power densities to continue increasing and reliability to continue improving, the need for efficient, compact cooling systems is growing.

## Technology

The Oak Ridge National Laboratory (ORNL) floating loop integrates the traction drive cooling system with the passenger air conditioning (A/C) system and shares some components of the passenger A/C system (i.e. piping, refrigerant, and condenser). This system provides the effective two-phase cooling directly for the inverter and motor. The

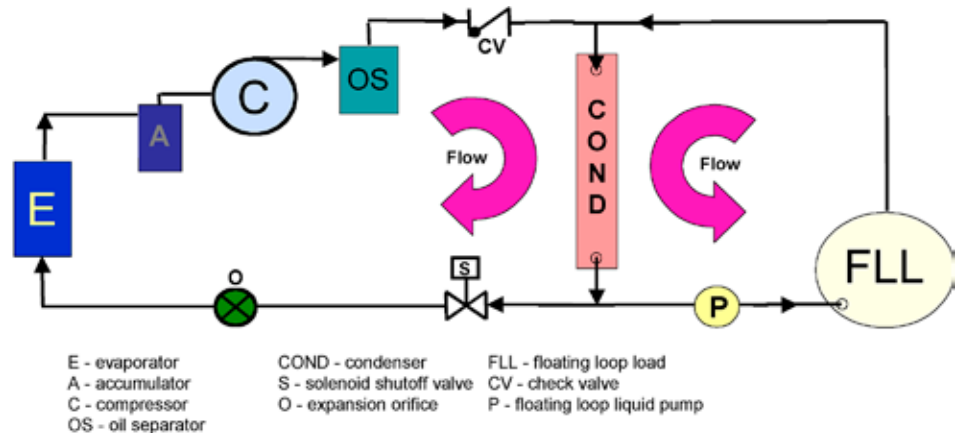


Figure 1. R134a integrated cooling system with floating loop

integration of this floating loop into the A/C system eliminates the need for a separate piping system, compressor, and heat exchanger. The integration only adds a small pump to promote flow through the new section of the refrigerant system.

Although sharing some components and piping, the cooling system remains operationally independent from the A/C system, allowing the subsystems to operate together or alone. The system provides two-phase cooling at 50 to 60°C, where traction drive heat is rejected to ambient through the refrigerant to surrounding air.

## Benefits

- Enables higher power density.
- Improves reliability and lifetime by lowering operating temperatures for the electronics.
- Allows increased silicon chip power throughput.
- Shares existing components under the hood of the vehicle.

## Status

Testing at ORNL has shown the cooling system to function well as an integrated part of the existing A/C system, and the floating loop system has demonstrated a coefficient of performance (COP) greater than 40 for the floating loop segment.

While work on this effort is still in its early stages, the current design is being optimized. ORNL is working closely with U.S. auto manufacturers to ensure that the R&D of this technology is closely aligned with industry needs, providing a clear path to commercialization in the future.

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